Note with respect to the Rate of Motion of Gaseous Matter projected from the Sun. By A. C. Ranyard, Esq.

Prof. Young, in the November number of the *American Journal of Science*, describes an exceptionally large prominence which he observed on the morning of October 7 last. He states that at 11 A.M. he saw a bright horn on the S.E. limb of the Sun. "When first seen, it was about 3′ or 4′ in elevation, but it rapidly stretched up and before noon reached a measured altitude of over 13′ (350,000 miles+) above the Sun's limb. It faded away and disappeared about $12^h\ 30^m$. It was brightest about $11^h\ 30^m$ with an altitude of about 8′."

If we suppose that the outburst was directed vertically upwards from a part of the Sun's surface near to the solar limb, so that there was no foreshortening, this observation would prove that the gaseous matter of the prominence was carried from a height of about 212,500 miles above the photosphere to a height of over 350,000 miles in less than thirty minutes. Comparing the rate of upward motion of the gaseous matter of the prominence with the velocity of a projectile thrown vertically upwards in free space to a similar height above the Sun's limb, we find that there is ample evidence to show that the matter of the prominence must have encountered considerable resistance, which caused it to pass over the distance traversed more rapidly than it would if it had moved freely under the action of solar gravity in empty space. Thus, since the time occupied by a projectile in passing upward from any level to the summit of its trajectory is equal to the time occupied by a body in falling under the influence of gravity from the higher to the lower level, we have —taking the Sun's radius as 425,000 miles, and the value of gravity at the level of the photosphere as ·169, where a mile is the unit of length and a second the unit of time—

$$\frac{d^2x}{dt^2} = -\frac{\cdot169 \times (425000)^2}{x^2},$$

where x is the distance in miles of the falling body from the Sun's centre, and

$$\left(\frac{dx}{dt}\right)^2 = \mathrm{V}^2 = \frac{2 \times \cdot169 \times (425000)^2}{x} + c.$$

If the body drop from a height a miles above the Sun's centre, we have $\mathrm{V}=0$ when $x=a$;

$$\therefore c = -\frac{\cdot338 \times (425000)^2}{x},$$

and

$$\left(\frac{dx}{dt}\right)^2 = \cdot338 \times (425000)^2 \left(\frac{1}{x} - \frac{1}{a}\right);$$

$$\therefore 425000\sqrt{\frac{\cdot338}{a}}\,\frac{dt}{dx} = \frac{x}{\sqrt{ax - x^2}};$$

which gives

$$425000\sqrt{\frac{\cdot 338}{a}}\,t = \sqrt{ax-x^2} - \frac{a}{2}\sin^{-1}\frac{2x-a}{a} + c;$$

when $t=0$, $x=a$

$$\therefore c = \frac{a}{2}\,\frac{\pi}{2};$$

hence we have

$$425000\sqrt{\frac{\cdot 338}{a}}\,.\,t = \sqrt{ax-x^2} + \frac{a}{2}\cos^{-1}\frac{2x-a}{a};$$

and for the time of falling from a height of 775,000 miles to a height of 637,500 miles above the Sun's centre we have

$$425000\sqrt{\frac{\cdot 338}{775000}}\,.\,t = \sqrt{(137500)(637500)} + 387500\cos^{-1}\frac{500000}{775000},$$

which gives

$$t = 2256 \text{ sec}$$
$$= 37^{\text{m}}\ 36^{\text{s}}.$$

Hence the matter of the prominence must have passed over the lower part of its course with a considerably greater velocity than would have been necessary to carry a projectile unimpeded by a resisting medium to the observed altitude above the photosphere attained by the prominence matter. It seems evident from Prof. Young's description that the matter of the prominence was not carried in a non-luminous condition to an altitude which exceeded the observed altitude, for the gaseous matter composing the higher part of the prominence seems to have been so brightly incandescent that it was more than half an hour in fading from view.

But the observed altitude may have corresponded to a much greater height above the photosphere than 350,000 miles, for the prominence may have been thrown up from a part of the Sun on this side or on the other side of the limb. The calculated time consequently corresponds to a minimum estimate of the time which would have been occupied by a projectile unimpeded by a resisting atmosphere in traversing the space between the observed altitudes.

If on a future occasion the time which the erupted matter occupies in attaining various altitudes can be carefully observed, some valuable deductions may no doubt be drawn with respect to the distribution of the resisting medium which observations made during total eclipses had already shown to exist in the region of the Corona.

The photographs taken during the Eclipse of 1871 show that the tree-like and curving structures observable on that occasion were more contorted in the lower than in the higher regions of